https://ntrs.nasa.gov/search.jsp?R=20070012323 2019-08-30T00:32:53+00:00Z

etadata, citation and similar papers at core.ac.uk

brought to you by

provided by NASA Technical Repor

Exploration Life Support

ELS Functions & Materials Interfaces

Advanced Life Support Analysis

- Centered around Unit Operations like:
  - Evaporation, Pervaporation, Adsorption, Desorbtion, of both liquids and gases
- Develop White Papers which allow us to take information from the literature and emphasize their applicability to ELS
- Tools include Aspen Custom Modeler which we have used to built a library of Tools and Unit Ops Models

Table 3 - Chemical composition of key materials (Ref 12, 29, 30, 32).

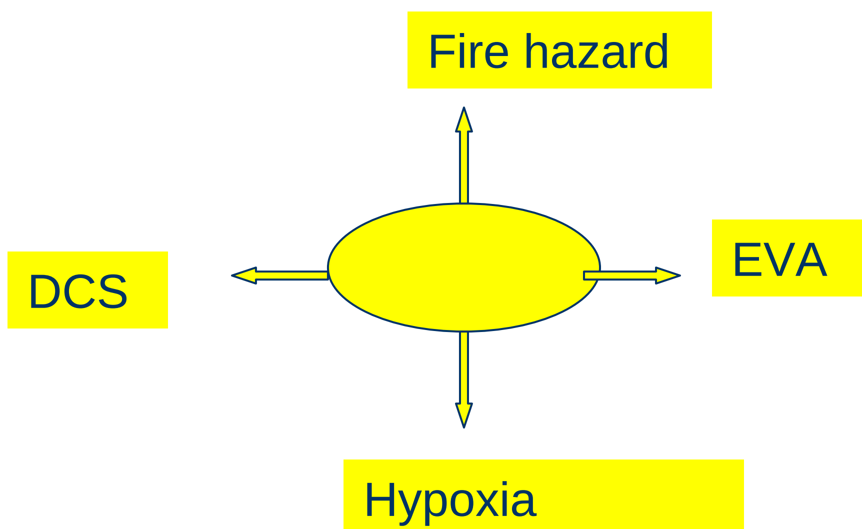
Material	ID	Atom	Z	A	Atoms/gram	Density g/cm³
Aluminum 2219	ALM	Al	13	27	2.08E+22	2.83
		Ti	22	48	7.53E+18	
		V	23	51	2.18E+19	
		Mn	25	55	3.31E+19	
		Cu	29	64	5.90E+20	
		Zr	40	91	1.19E+19	
Poly-etherimide	PEI	H	1	1	2.44E+22	1.27
		C	6	12	3.76E+22	
		N	7	14	2.03E+21	
		O	8	16	6.10E+21	
Polysulfone	PSF	H	1	1	3.00E+22	1.24
		C	6	12	3.68E+22	
		O	8	16	5.45E+21	
		S	16	32	1.36E+21	
Poly-ethylene	PET	H	1	1	8.60E+22	0.92
		C	6	12	4.30E+22	
Water		H	1	1	6.69E+22	1.00
		O	8	16	3.34E+22	
Food (Molasses)		C	6	12	2.01E+22	1.48
$C_6H_{12}O_6$		H	1	1	4.01E+22	
		O	8	16	2.01E+22	
Carbohydrate	CHO	C	6	12	2.01E+22	0.81(granulated sugar)
$C_6H_{12}O_6$		H	1	1	4.01E+22	
		O	8	16	2.01E+22	
Fat		C	6	12	3.76E+22	0.93(Crisco)
$C_{16}H_{32}O_2$		H	1	1	7.53E+22	
		O	8	16	4.70E+21	
Protein		C	6	12	2.90E+22	0.93(gelatin)
C_4H_5ON		H	1	1	3.63E+22	
		O	8	16	7.26E+21	
		N	7	14	7.26E+21	
Fiber		C	6	12	2.23E+22	
$C_6H_{10}O_5$		H	1	1	3.72E+22	
		O	8	16	1.86E+22	
Lithium Hydride	LIH	H	1	1	7.53E+22	0.82
		Li	3	7	7.53E+22	
Liquid methane	LME	H	1	1	1.51E+23	0.47
		C	6	12	3.76E+22	
Graphite nanofibers	GNF	H	1	1	4.04E+23	2.25
		C	6	12	1.63E+22	
Liquid hydrogen	LH2	H	1	1	6.02E+23	0.07

Summary of Recommendations for Constellation Mission Systems

Vehicle	Nominal Total Pressure	Nominal Oxygen Partial Pressure (mmHg) [4]	Nominal Oxygen Concentration (%	Range of Total Pressure Capability	Tissue Ratio (R) After 60 Minutes Prebreath
CEV to ISS	14.7 10.2[5]	160 (0 ft) 140 (3500 ft)	21 26.5	0-14.9	
CEV In-Space Suit	4.3	222	100	4.0-4.6	1.55 from 10.2 psia CEV to 4.3 psia suit
Lunar and Mars CEV	14.7 10.2	160 (0 ft) 140 (3500 ft)	21 26.5	0-14.9	
Lunar and Mars Landers	10.2 8.0	140 (3500 ft) 132 (5000 ft)	26.5 32	0-14.9	
Lunar and Mars Surface Suits	4.3 6.0	222 310	100 100	3.5-8.0 [2]	1.13 from 8.0 psia Landers to 4.3 psia suit; 1.07 from 7.6 psia Surface Habitats to 4.3 psia suit
Lunar and Mars Surface Habitats	8.0 7.6	132 (5000 ft) 126 (6500 ft)	32 32	0-14.9	
Mars Transit	14.7 10.2	160 (0 ft) 140 (3500 ft)	21 26.5	0-14.9	

Note 1: Range of total pressure capability covers Earth launch, Earth entry, and contingencies.
Note 2: Surface suit 3.5 psia capability for suit emergency operations, 8.0 psia for DCS treatment.
Note 3: 60 minute in-suit prebreathe is defined as the time in the suit after purge and leak check until absolute pressure on the body reaches 4.3 psia after a nominal depressurization. Nitrogen is assumed diluent gas.
Note 4: All nominal values are centers of control boxes assumed +/-0.2 psia total pressure, +/-2% oxygen.

Exploration Atmospheres



Events Leading Up to the EAWG

- Data on DCS came mostly from Dr. Johnny Conkin who in turn obtained a good deal of data from Brooks Air Force Base in San Antonio. Dr Conkin’s work is involved with DCS Physiology.
- Our involvement started trying to define the atmosphere necessary for a successful Mars mission which was felt by many to have many EVA’s to make it a success.
- Formed a working group led by Dr Don Henninger at JSC where experts in all the associated fields were invited to participate

Bounding the Spacecraft Atmosphere Design Space for Future Exploration Missions

June 2005
NASA/CR—2005–213689

Bounding the Spacecraft Atmosphere Design
Space for Future Exploration Missions

Kevin E. Lange, Alan T. Perka, Bruce E. Duffield and Frank F. Jeng
Jacobs Sverdrup ESC Group
Houston, Texas

Flammable Materials at oxygen enriched atmospheres

- In order for ignition to occur there must be present: oxidizer, fuel, and ignition energy
- A flammable substance in the presence of O_2 requires only the necessary energy and combustion can occur
- Materials used in the EVA suit loop for CEV must be evaluated for use in 100% oxygen environments

$P := 7, 7.1 .. 16$

$f(P) := .3 \cdot P$

$y := 3$ $\quad$ $f2(P) := (.3 \cdot P) + .116$

$x := 10.2$ $\quad$ $f3(P) := .3 \cdot P - .116$

$g(P) := 2.7$ $\quad$ $g3(P) := 2.6 + .116$

$g1(P) := 2.5$ $\quad$ $g4(P) := 3.1 - .116$

$g2(P) := 3.44$ $\quad$ $g5(P) := 2.6$

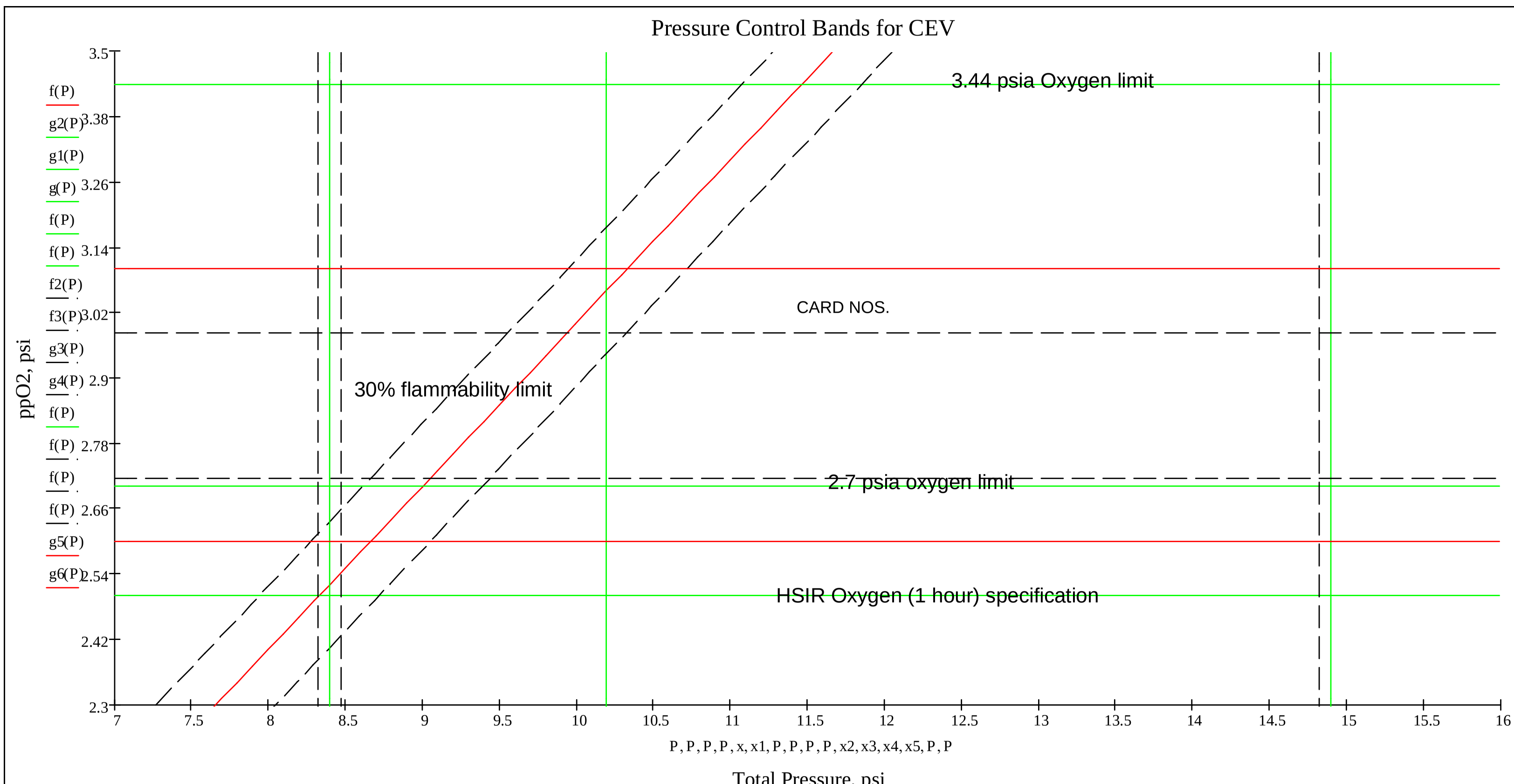
$g6(P) := 3.1$

$x1 := 14.9$

$x2 := 8.4$ $\quad$ $x4 := x2 - .075$

$x3 := x2 + .075$ $\quad$ $x5 := x1 - .075$

All error bands are set at +/- 2% of full scale (5.8 psi) for ppO2 (=0.116 psi) and at =/- 0.5% of FS (30 mV) for total pressure sensor (assumes 15 psi is 30 mV at full scale) per D684-10508, Volume 2, Book 02, Rev C of the ISS ECLS Architecture Description Document. pages 3.2-64 and 3.2-72. According to Kevin Lange the error bands are taken into consideration by the materials experts when the materials are evaluated.



Design Space Initiated by Lange, et.al. and used by the EAWG